Improving the Imaging of Blood Vessels

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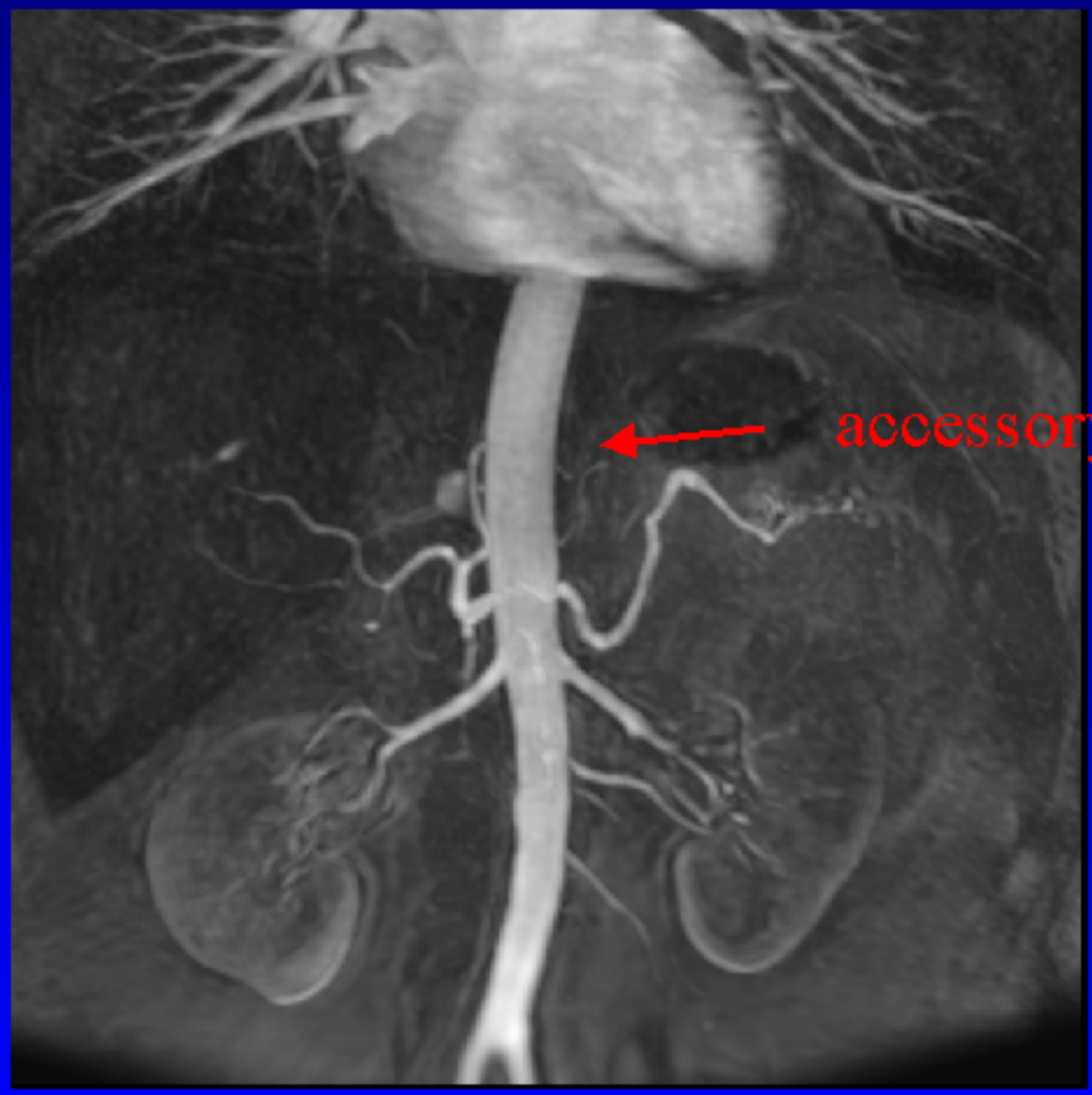
Magnetic Resonance Angiography (MRA)

- Application:
  - Detection and evaluation of atherosclerosis.
  - Assessment of vascular anatomy for surgical planning.
- Advantages over conventional angiography:
  - Non-invasive.
  - Three-dimensional.
  - Obtain blood vessel shape *and* blood velocity.

MRA Interpretation Problems

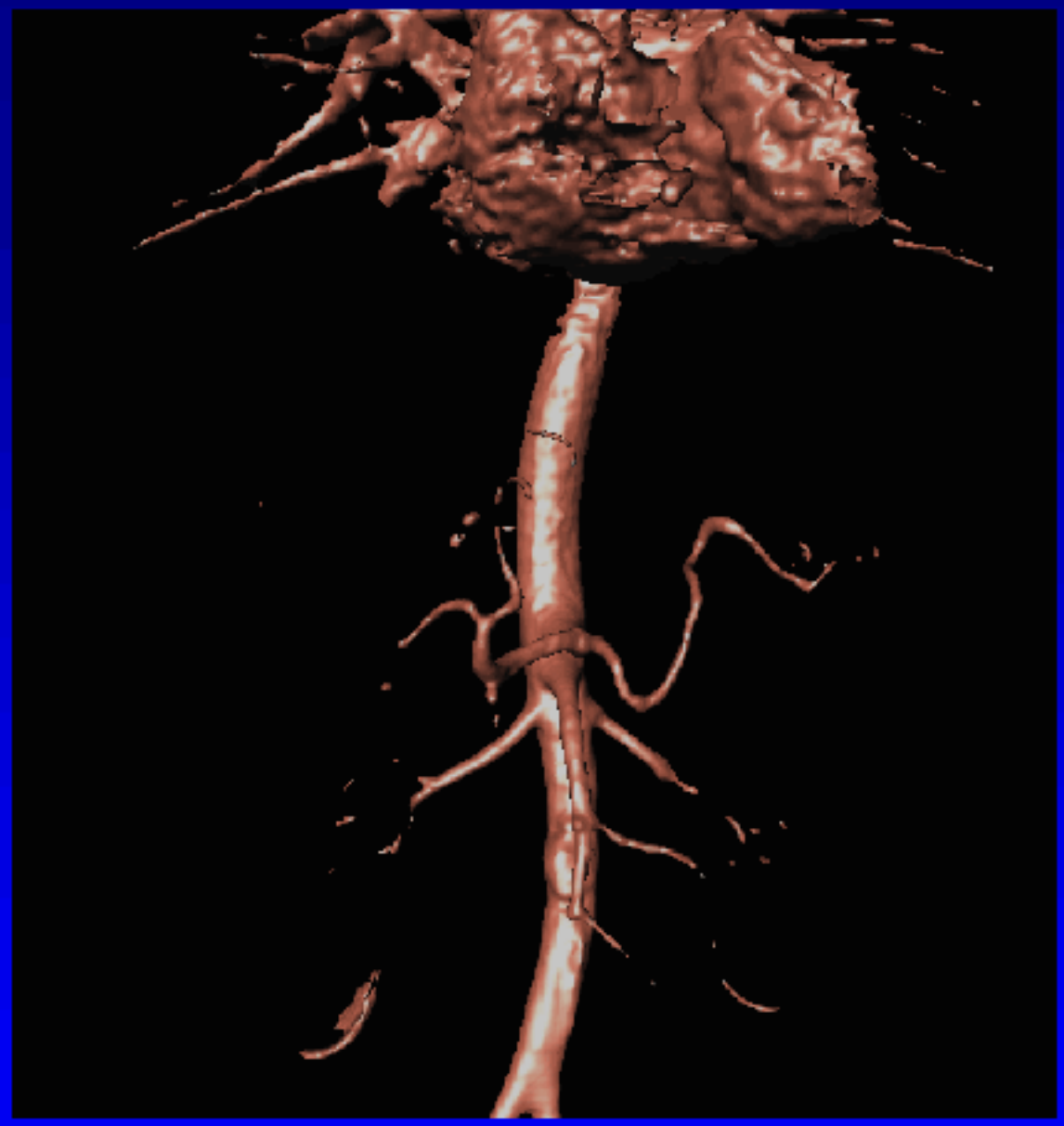
- Smaller vessels have low contrast and are easily obscured.
- Measurement of stenosis of vessel is subjective.

Visualization of Hepatic MRA



Maximum Intensity Projection.

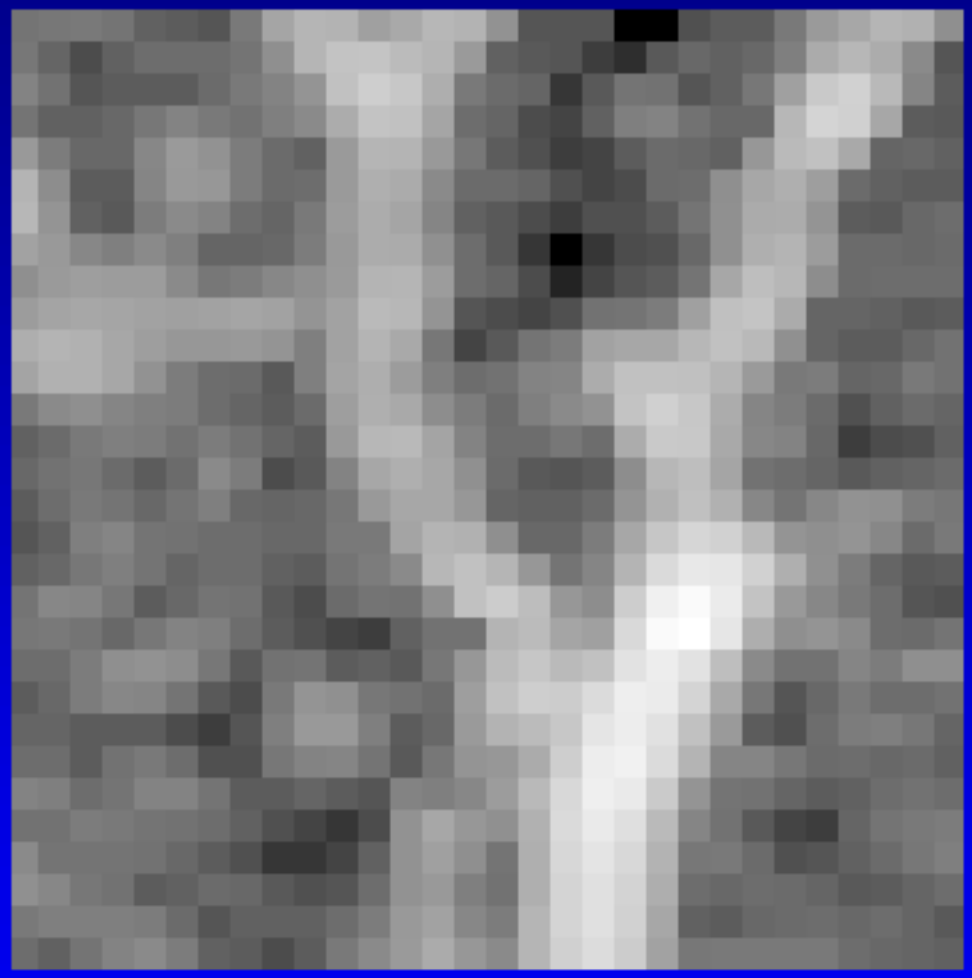
A simulated projection image based on a series of 2D slices.

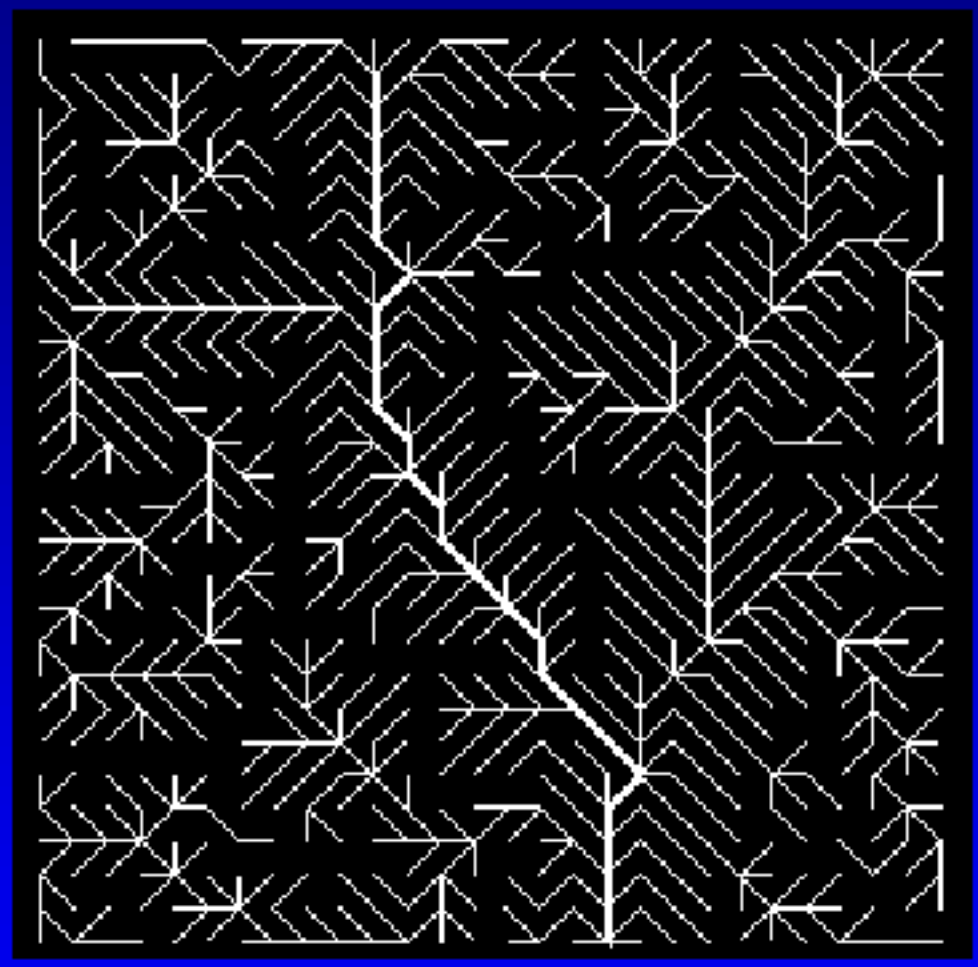


Iso-intensity Surface.

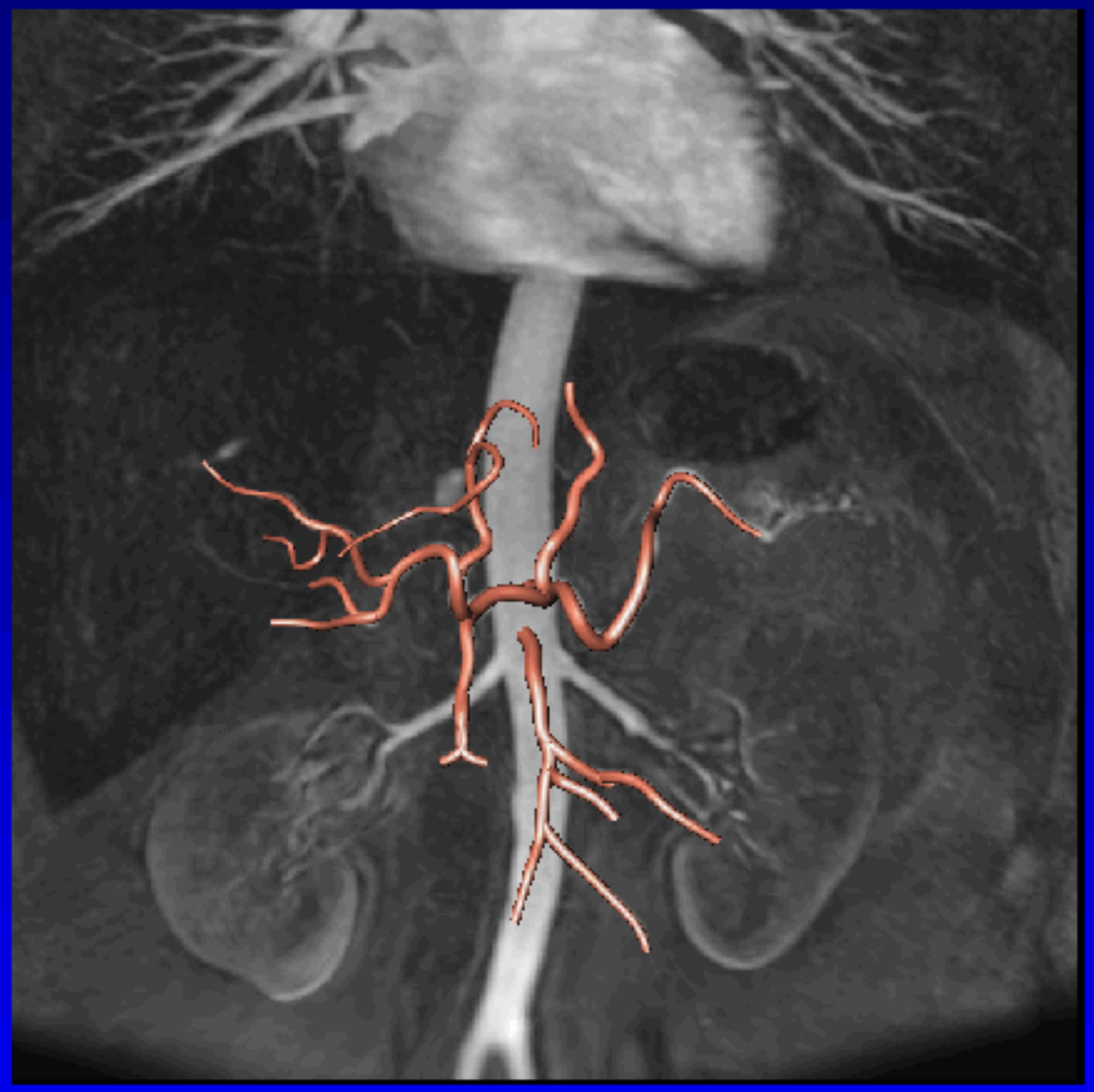
A 3D shaded surface display for a given intensity level.

Skeletonization Approach





- Transform image to set of lines.
- Principle originated in analysis of elevation maps.



Skeletonization.

Endpoints of each vessel is indicated by user.

Paths of each vessel are determined in real-time.

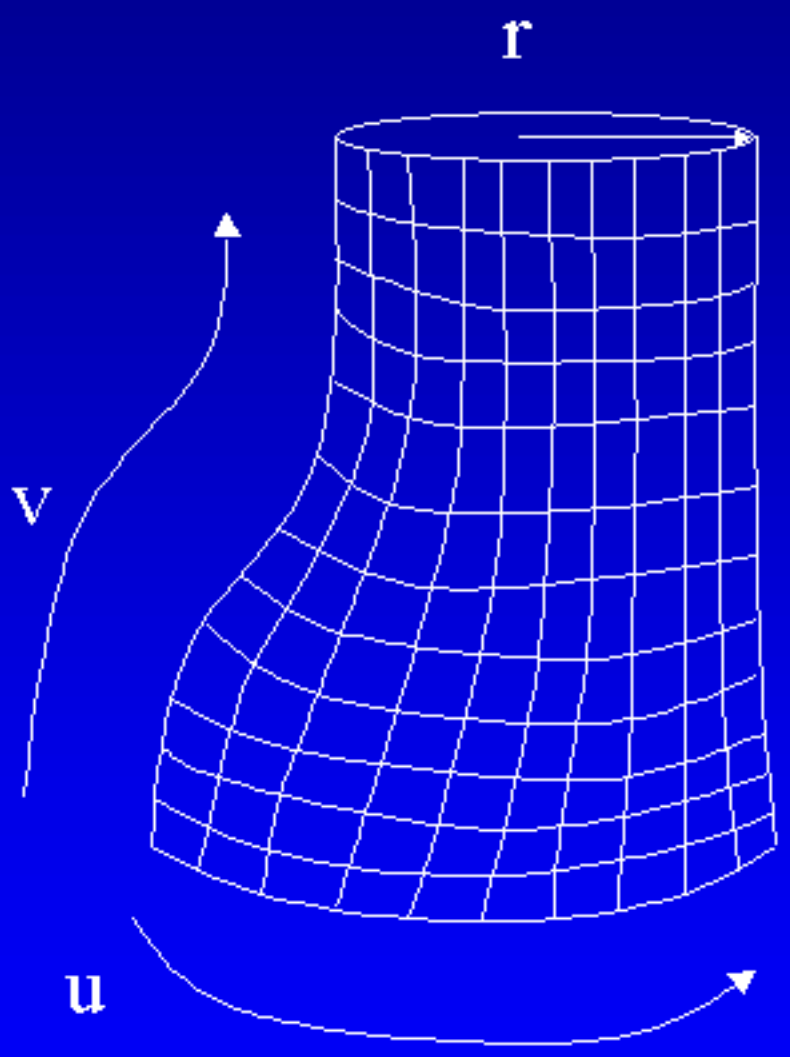
Quantification of Stenosis

- Patients with >70% stenosis of the carotid artery are recommended for endarterectomy.
- Measurement of the degree of stenosis from angiography is subjective.

Stenosis of the Carotid Artery

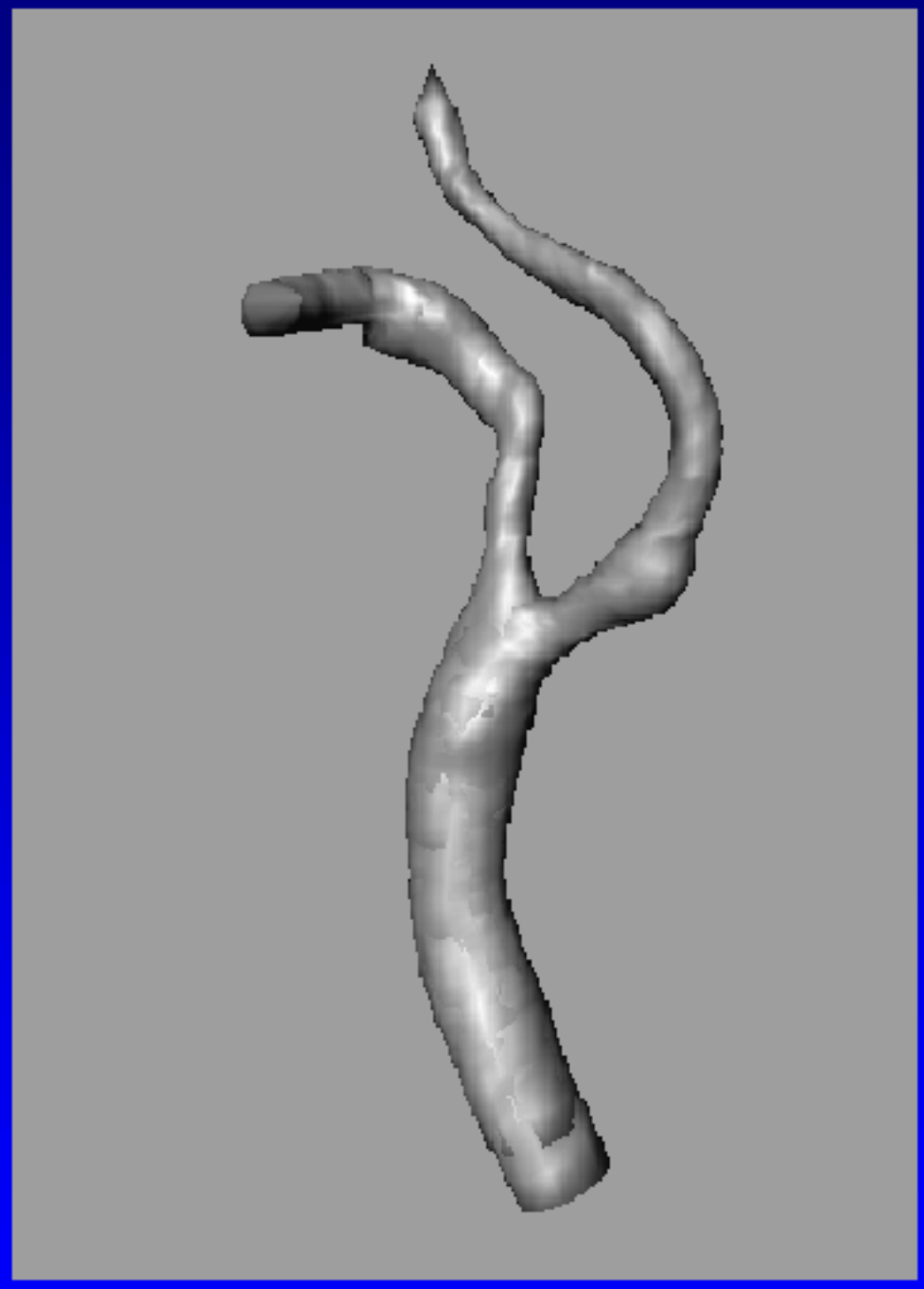
Maximum Intensity Projection

Deformable Model Approach



Find cylindrical mesh which best fits the surface of the vessel.

Maximum Intensity Projection



Deformable Model

Conclusions

- Computational methods can improve the visualization and analysis of magnetic resonance angiography.
  - Improve objectivity of analysis.
  - Improve accuracy of analysis.
  - Provide information about vessels which is otherwise unavailable.